

LIST OF REFERENCE-LETTERS.

<i>bl.</i> Muscular bladder of nephridium.	<i>lv.</i> Longitudinal lateral vessel.
<i>buc.</i> Buccal region of gut.	<i>m.</i> Pore of sperm-duct.
<i>cl.</i> Clitellum.	<i>N.</i> Ventral nerve-cord.
<i>cop.</i> Sac with the copulatory chætæ.	<i>ne.</i> Nephridiopore.
<i>d.</i> Muscular duct of spermatheca.	<i>o.</i> Ovary.
<i>div.</i> Diverticulum of spermatheca.	<i>od.</i> Oviduct.
<i>d.ne.</i> Dorsal nephridium.	<i>oe.</i> Oesophagus.
<i>d.v.</i> Dorsal blood-trunk.	<i>p.</i> Opening of spermiducal gland on porophore.
<i>f.</i> Funnel, of nephridium (fig. 6), of sperm-duct (fig. 7).	<i>ph.</i> Pharynx.
<i>g.</i> Gizzard.	<i>pro.</i> Prostomium.
<i>gl.</i> Oesophageal gland.	<i>s.</i> Copulatory sac of spermatheca.
<i>h.</i> Heart.	<i>s i.v.</i> Supra-enteric blood-vessel.
<i>i.</i> Intestine.	<i>sp.d.</i> Sperm-duct.
<i>i.h.</i> Enteric heart, arising from supra-enteric vessel.	<i>sp.gl.</i> Spermiducal gland.
<i>L.</i> Lateral couple of chætæ.	<i>sp.s.</i> Sperm-sacs, or seminal vesicles.
<i>l.h.</i> Lateral heart, arising from dorsal blood-trunk.	<i>spth.</i> Spermatheca.
	<i>t.</i> Coil of nephridial tubules (fig. 6), testis (fig. 7).
	<i>V.</i> Ventral couple of chætæ.
	<i>v.ne.</i> Ventral nephridium.
	<i>v.v.</i> Ventral blood-trunk.

ART. VIII.—On some Earthworms from the Islands around New Zealand.

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[Read before the Otago Institute, 13th November, 1900.]

Plates II.—IV.

OUR knowledge of the earthworms of the South Island of New Zealand is now fairly extensive, thanks to the work of Mr. F. E. Beddard, to whom material was sent from time to time by the late Professor Parker and Mr. W. W. Smith; but we know very little as yet of the worms of the North Island and of the outlying islands. I have been fortunate in obtaining material from various friends, and am working upon this material. In the present communication I will concern myself with worms from the Snares (lying south of New Zealand), the Macquaries (still further south), and the Chatham Islands (on the east of the southern portion of New Zealand).

During a recent trip to the Macquarie Islands Dr. D. Colquhoun thoughtfully collected, on the Snares and Macquaries, some earthworms and preserved them in formol, and most kindly handed them over to me. To him my thanks are

due. The material from the Chathams was given to me by Captain Hutton, who received a quantity of material collected by Mr. J. J. Fougère. Captain Hutton, with that liberality that is characteristic of him, has handed over to me all the earthworms contained in his collection at the Canterbury Museum. Further, Mr. H. B. Kirk and Mr. L. Cockayne have provided me with specimens from the same islands.

As a result of my examination, I have to form four new species, one of which had, however, been previously partially described as a "variety" by Michaelsen. The new species are: *Acanthodrilus haplocystis*, from the Snares, and *Microscolex huttoni*, *Diporochæta chathamensis*, and *Pontodrilus chathamensis*, Mich., from the Chathams. In addition, I can add several details to Beddard's account of the very interesting species from Macquarie Island, *Acanthodrilus macquariensis*, F.E.B., and record the existence of the world-wide *Allolobophora caliginosa* and *Allol. rosea*, Sav., from the Chathams, introduced by the direct agency of man.

For the present I shall give the characters of the species in a very brief form, as I hope to deal with the whole earthworm fauna in an extended manner elsewhere.

1. *Acanthodrilus haplocystis*, n. sp.

Two specimens, preserved in formol, collected by Dr. Colquhoun at the Snares Island.

Colour.—Light-brown, with a darker ring round the hinder half of each segment in the postclitellian region, giving a coloration not unlike that of *A. annectens*.

Dimensions.—Length, about $11\frac{1}{2}$ in. by $\frac{1}{4}$ in. (= 290 mm. by 6 mm.); cylindrical; with two hundred segments, which, in the preclitellian region, are much annulated.

Prostomium with prolongation over half the buccal segment.

Chætæ.—In couples; a ventrally placed couple and a laterally placed couple. The separation of the individuals of a couple is equal—i.e., $ab = cd$; V (ventral gap) = $2 ab$; D (dorsal gap) = $5 ab$; L (lateral gap) = $1\frac{1}{2} ab$.

Clitellum.—Ill-defined, except by its coloration; covers segments 13 to 19 inclusive. The "spermatic groove" connecting the porophores of 17 and 19 is curved, concave ventrally, passing outside the ventral couple of chætæ. The latter (ab) are present on each* of the segments 17, 18, 19, for there are no specialised penial chætæ.

Genital Pores.—Male pores on segment 18 as usual; spermathecal pores between $\frac{7}{8}$ and $\frac{8}{9}$ in line with chætæ b . Each pore is surrounded by a distinct glandular area, above

* In the immature specimen; in the mature one, however, a alone is present in 17, 19.

which is an oval glandular patch, extending up to the level of chæta *c*. Each oval patch really consists of a crescentic patch on the hinder edge of 7, and another on the anterior edge of 8 (and so with segments 8 and 9). In addition to these there is a similar oval "tuberculum pubertatis," or "genital papilla," on the intersegmental grooves 9/10, in a line with chæta *a*. Thus there are three pairs of preclitellian "tubercula pubertatis."

Nephridiopores in a single series in line with chætæ *b*. They are invisible externally in the preserved worm, but can be traced from within.

Internal Anatomy.

Septa forming the posterior boundaries of segments 7 to 14 inclusive are more or less thickened.

Vascular System.—The dorsal vessel is completely duplicated, not uniting to pass through the septa. There are four pairs of "intestinal hearts" in segments 10 to 13, and a smaller "lateral heart" in the 9th segment.

Alimentary Tract.—The gizzard is in segment 6; the œsophagus is dilated in segments 15 and 16: it has here highly vascular and lamellate walls, but is without any lime-particles. The œsophagus thence narrows to the 19th segment. The intestine commences in segment 20, and is without a typhlosole.

Nephridia.—The worm is meganephric, the organs being in a single series. One peculiarity is to be noted—viz., the absence of a muscular duct. The nephridia of the segments 3, 4, 5 are large and pink. I traced their ducts to the body-wall, and saw none entering the buccal region of the gut. No doubt they junction as "peptonephridia."

Reproductive Organs.—The two pairs of testes lie in segments 10 and 11, free in the cœlom, attached to the anterior wall. The sperm-sacs are in three pairs, those in segments 9 and 10 attached to hinder septum, and a larger pair attached to the front septum of the 12th segment. The spermiducal glands are thick, much convoluted tubes, compressed and compacted to form, apparently, a lobed mass. Each is confined to its own segment. The duct is short and narrow. Penial chætæ are absent. Spermathecæ: Two pairs in the usual segments; each is a simple ovoid sac, with a rather prominent equatorial region, the proximal portion being rather more muscular than the distal. There is no definite duct. There is no diverticulum; and sections demonstrate that none exists embedded in the body-wall. The simple character of this organ suggests its specific name, for, without exception, I believe, members of the genus *Acanthodrilus* (s.l.) have a diverticulum.

Affinities.—There is undoubtedly a very close affinity with the species *A. annectens* and *A. paludosus*, which, as Beddard has shown, differ in many respects from other members of *Acanthodrilus*, and approach in some respects to *Octochætus*. The present species is larger than either of these. In coloration and in certain details—in absence of muscular duct to the nephridium, absence of penial chætæ—it resembles *A. annectens*, from which it differs, however, in the position of the gonads, in the form of the spermatheca, and some other details: while from *A. paludosus* its size marks it off, as well as such details as the position of sperm-sacs and the form of spermatheca.

In a previous note (see page 123) I have referred to the fact that Michaelsen (*loc. cit.*, page 233) has proposed a subdivision of the genus *Acanthodrilus* into a number of genera. With some of his reasons I agree, but I do not as yet feel convinced of the possibility of erecting the genera *Maoridrilus* and *Notiodrilus* for such species respectively as have nephridiopores alternately in line with dorsal and ventral chætæ, and for those in which all the pores are in line. As subgenera the names are certainly convenient, and the present species belongs to the subgenus *Notiodrilus*.

2. *Acanthodrilus macquariensis*, Beddard.

Two specimens were collected by Dr. Colquhoun. The species was originally described by Beddard(7) from two sexually mature and several immature specimens. Its great interest lies in the fact that it has closer affinities with the species occurring in Patagonia, the Island of South Georgia, and the Falkland Islands than with those of New Zealand.

Colour.—Light greenish-brown (in formol). The pigment confined to the dorsum of the anterior 30 segments, while posteriorly the pigment is absent.

Dimensions.—A small cylindrical worm, measuring about $1\frac{1}{2}$ in. by $\frac{3}{16}$ in. (*i.e.*, 40 mm. by 4·6 mm.) in diameter. The body consists of 83 and 85 segments respectively. (Beddard finds 100 segments.)

The *prostomium* is prolonged backwards through half the length of the buccal segment. (Beddard states that it does not divide this segment.)

The *chætæ* are very nearly equidistant, though the dorsal couple (*cd*) are slightly further apart than the ventral. The relative distances, as measured on the skin spread out on a slide, are: $ab = 4$, $L = 5$, $cd = 5$, $V = 7$, $D = 10$.

The *clitellum* covers segments 13 to 16 and 13 to 17 in the two individuals; the intersegmental grooves, however, remain distinct, and the colour is scarcely different from that

of preclitellian region. (Beddard found it only extending as far as the 16th segment.)

Genital Pores.—The usual “porophores” exist on segments 17 and 19, and are very distinct papillæ. The ordinary ventral chætæ are here absent; but both are present on the 18th segment, and the “spermathecal groove” passes outside them. The two pairs of spermathecal pores have the usual position. The ventral surface of the body on segments 7 to 10 is much swollen, and paler than the rest. On the 10th segment is a pair of large “tubercula pubertatis,” or papillæ, surrounding the ventral chætæ (*ab*) of each side; each is slightly cupped, and the two nearly meet one another. These were present on each of the two individuals. (Beddard’s specimens appear to have been somewhat abnormal.)

Nephridiopores in line with chætæ *c*.

Internal Anatomy.

Vascular System.—The dorsal vessel is duplicated up to the 11th segment at least, and the last heart is in the 13th segment.

Alimentary Tract.—The gizzard is absent. The œsophagus is suddenly dilated in the 16th segment, and both in this and the next has whitish walls, with a few longitudinal ridges within; these lamellæ can be traced forwards, becoming more numerous in 15 and 14, where they become irregular, and take an oblique direction; they increase in size and irregularity in segments 13, 12, and 11, till they considerably reduce the lumen. From the 17th segment the œsophagus continues backwards, unconstricted, through the 18th and 19th segments, to pass into the intestine in the 20th segment, where the gut has now thin walls without any folds. Beddard states that “the intestine appears to begin in the 17th segment.” In this I believe he is mistaken: the structure of the œsophagus and the intestine is sufficiently distinct in sections to allow me to state that the intestine commences in the 20th segment, after which it is sacculated.

Reproductive System.—The two pairs of testes have the normal position; they and the funnels are “free.” There are two pairs of lobulated sperm-sacs in segments 11 and 12. The spermiducal glands I find to be large, with a narrow duct. The penial chætæ are very delicate, ornamented, as Beddard states, with “scattered triangular tubercles, rounded at the tip”; but he overlooked the fact that the chætæ are hooked at the end. I find three, or even four, couples of penial chætæ in each sac. The spermathecæ are pyriform sacs, each with a long, thick, muscular duct about equal to the length of the sac. The sac and its duct are bent at an angle, and at this point there enter a couple of small oval diverticula, one on each side of the duct.

The following earthworms were collected at the Chatham Isles:—

1. *Allolobophora caliginosa*, Sav. Several; from a peat swamp; collected by J. J. Fougère.

2. *Allolobophora rosea*, Sav. Collected by Mr. L. Cockayne, and presented to me by Dr. Dendy.

3. *Lumbricus*, sp. Small and immature.

The above are introduced, being more or less world-wide, though their home is Europe.

4. *Diporochæta chathamensis*, n. sp. From a peat swamp; collected by J. J. Fougère.

5. *Pontodrilus chathamensis*, Michaelsen. Collected on the sea-beach, in Shelly Land, by Mr. J. J. Fougère; and other specimens by Mr. H. B. Kirk "from near the mouth of the Waitangi Stream. They live," he says, "in what appears to be pure sea-sand, and at high tide are covered by brackish water. They probably feed on decaying seaweed."

6. *Microscolex huttoni*, n. sp. Collected in the bush by J. J. Fougère.

3. *Diporochæta chathamensis*, n. sp.

Seven specimens were collected from a peat swamp; preserved in formol.

Colour.—Pale-pink; no pigment.

Dimensions.—2 in. long by $\frac{1}{16}$ in. in diameter (*i.e.*, 50 mm. by 1.5 mm.). The worm is thus very slender; the segments relatively long and well marked. Usually about 100 segments, though one specimen of the usual size consists of only 57 segments.

The *prostomium* is partially embedded in the buccal segment for about one-third the length of the latter, but it has no posterior bounding furrow.

The *chætæ* are sixteen in each segment throughout the worm, eight on each side, at nearly equal distances apart. The dorsal gap is only about one and a half times the normal gap, the ventral gap rather greater. The *chætæ* are more distinctly hooked than in most worms.

The *clitellum* is yellowish, and complete. It covers segments 14, 15, and 16. The intersegmental grooves and the *chætæ* are still evident.

Genital Pores.—The male pores are on the 18th segment, each on a large, depressed, oval, white papilla; the two "porophores" meet one another medially, forming a dumb-bell-shaped glandular band extending right across the segment. The actual pore (though invisible under a lens) is in line with the most ventral *chætæ*. Two transverse "tubercula pubertatis," on the intersegmental grooves 17/18 and 18/19 respectively, meet the dumb-bell, and the whole glandular structure

forms a conspicuous octagonal area on this 18th segment. The oviducal pores are separate, and lie within a pale area, contrasting well with the yellow glandular substance of the clitellum. Spermathecal pores are invisible, but sections show that there are three pairs on the furrows 5/6, 6/7, and 7/8.

Nephridiopores in line with the fourth chæta from below.

Dorsal pores commence behind the 7th segment, and are evident along the entire length of the body.

Internal Anatomy.

Alimentary Tract.—The small gizzard is quite definite in segment 5; it has very thick walls, and a narrow lumen; its external diameter, however, is not greater than that of the œsophagus. The latter is provided with four pairs of lamellate sacs (œsophageal glands) in segments 12, 13, 14, and 15. The intestine commences in segment 17, and is without a typhlosole.

Reproductive System.—There is but a single pair of testes in segment 11, and a single pair of sperm-sacs in the 12th, but the preceding segment is filled with loose sperms. The sperm-duct passes straight backwards along the body-wall at the level of the nephridiopores as far as the 18th segment, where it bends to traverse this segment at right angles to its former course. The spermiducal gland is elongated and tubular, passing backwards into the 21st segment, where its free end is slightly coiled. It joins the sperm-duct at the above-mentioned bend. There are no special penial chætæ. The ovaries and ducts are normal. The spermathecæ are three pairs, in segments 6, 7, and 8; each is an ovoid sac, without a distinct duct and without a diverticulum.

Affinities, &c.—The genus *Diporochæta* is Australian. Of the twenty-six species hitherto known, all but one (*D. intermedia*, Beddard,* which is a native of New Zealand) occur in Victoria, New South Wales, and Queensland. The occurrence of a second species in New Zealand is thus of some interest. The present species differs from *D. intermedia* in several points, chief amongst them being the single pair of testes and of sperm-sacs, the possession of three pairs (instead of four) of spermathecæ, and the 16 instead of 75 chætæ per segment. In fact, only one other species possesses a single pair of male organs—viz., *D. maplestoni*, Spencer,† from Victoria. This has, however, two pairs of spermathecæ and fewer chætæ—viz., 8 to 14 per segment—and fewer anteriorly than posteriorly. *D. walhalla*, Spencer,‡ has one pair of sperm-sacs in segment 12, but

* (1), p. 380, and (3).

† (2), p. 64.

‡ (1), p. 15.

Beddard, in his "Monograph," does not say that there is a single pair of testes, and I have not Spencer's paper at hand to refer to; anyhow, *D. walhalla* differs in having five pairs of spermathecae and 20-24 chaetae per segment. *D. maplestoni* has, moreover, spermiducal glands and spermathecae of quite a different form (though there is no diverticulum); it differs also in the arrangement of the genital papillae. In the latter matter *D. lindti*, Spencer,* and *D. dicksonia*, Spencer,† bear a closer resemblance to our own species than do any of the others, but in all other features are very different. It is possible, of course, that *D. chathamensis* has been introduced into the Chathams from Australia by man, though it is noteworthy that it differs from all those twenty-six other species carefully examined by Spencer and by Fletcher.

4. ***Pontodrilus chathamensis***, Michaelsen = ***P. matsushimensis***, var. ***chathamensis***, Mich.

Of this worm I have a good supply of material, partly collected, as I have said, by Mr. J. J. Fougère, to whom I am indebted for fourteen individuals preserved in formol, and partly by Mr. H. B. Kirk, who handed me ten individuals preserved in alcohol.

The genus *Pontodrilus* is the only earthworm that lives actually within reach of the sea—in fact, between tide-marks. For reasons discussed below I believe this Chatham Islands form is worthy of being considered a distinct species, while Michaelsen, who, it is true, had very poor material, regards it as a local variety of a Japanese species.

Colour.—The formol specimens are pale-buff, distinctly pink anteriorly, with a brown clitellum.

Dimensions.—The length of the formol specimens is about $4\frac{1}{2}$ in.; some attain a length of 5 in. The alcoholic individuals, however, average only 3 in., though both sets are mature. The postclitellian diameter is $\frac{3}{16}$ in. in both lots. The worm contains about 80 to 130 segments, long and triannulate in posterior region, while the anterior segments are even quinannulate. The animal is cylindrical.

The *prostomium* is prolonged into the dorsum of the buccal segment for fully a quarter the length of the latter. All my specimens show the prolongation quite distinctly, but the lateral furrows do not reach the posterior groove of the buccal segment, as in the figure given by Jizuka.

The *chaetae* have the usual arrangement in four couples, the individuals of which are rather far apart: $ab = cd = 3$, $L = 5$, $V = 6$, $D = 8$.

* (2), p. 54.

† (1), p. 16.

The *clitellum* is saddle-shaped, covering segments 14 to 17 usually, though in some individuals it encroaches on the 13th and 18th segments. Its ventral margin is a fairly distinct ridge, in line with the ventral chætæ. It is true that sections show (as in many other "incomplete" clitella) a glandular thickening of the epidermis on the ventral surface, but this is only very slightly thicker than the normal epidermis. The intersegmental grooves and the ventral chætæ are perfectly evident.

Genital Pores.—The male pores are not evident externally, but their position is indicated on the 18th segment by the characteristic specialisation of the lower surface of this segment, resulting in a prominent and thickened ridge on each side, limiting and overhanging a depression, which is deeper laterally below the ridge than in the middle of the segment. The anterior and posterior boundaries of this transverse depression are more or less prominent, so that a somewhat rectangular pit is formed; in this lie the microscopic male pores, in the lateral deeper regions, in line with chæta *b*. The two oviducal pores occupy the usual position, in front of and mediad of chæta *a*. There are two pairs of spermathecal pores, between segments 7/8 and 8/9; each is on a small papilla—very distinct in the formol specimens—which in reality belongs to the anterior margin of the 8th and 9th segments respectively, but as the papillæ overlap the furrow they appear to be intersegmental (as is the truth with regard to the "intersegmentally" situated spermathecal pores in other worms). "Tubercula pubertatis" are very characteristically developed—as oval intersegmentally placed glandular areas, with well-defined margins, slightly depressed centrally, and probably acting as suckers. There are two preclitellian and one postclitellian in position, situated at 11/12, 12/13, and 19/20. In the eighteen mature specimens at my disposal these three are universally present; in three instances the postclitellian is rather small, and in one case an additional tubercle exists at 20/21. In another individual an additional preclitellian tubercle is present at 13/14. I shall return to these papillæ in discussing the specific value of the worm.

Nephridial pores commence only at the 13th segment, and in line with chæta *b*.

Internal Anatomy.

The *septa* behind the segments 7 to 11 are much thickened and infundibuliform, those at 6/7 and 11/12 less so, though stouter than the following; the normal posterior *septa* are thinner than in most earthworms of this size.

Alimentary Tract.—The gizzard is small, but highly mus-

cular, with thick walls; it occupies segment 5. (I find the best way of locating the position of this organ is by slicing the worm in two by a horizontal cut, for by the ordinary method of dissection the septa are torn, especially when they are infundibuliform.) The œsophagus is narrow; it is slightly dilated in 13, 14, and 15 to form rather globular diverticula, with feeble lamellæ internally; in segments 16 and 17 it widens out, but retains the lamellate structure of its wall. These gradually die out and the intestine commences in segment 20; it is wide, uncontracted, and differs structurally from the œsophagus.

Reproductive Organs.—There are the usual two pairs of testes in 10 and 11, and two pairs of lobulate sperm-sacs in the 11th and 12th segments. The spermiducal gland is a thick irregularly cylindrical tube of some length, coiled somewhat, though not to so great an extent as in the Japanese species. The coils lie in a plane, are compressed and compacted to form what looks like a flattish lobed mass, till carefully unravelled. The gland occupies only segments 18 and 19 in the specimens examined. The muscular duct is very short and narrow, hidden below the glandular mass, which has to be lifted and turned aside; but then it is quite distinct. This duct is not bent upon itself as in the Japanese species, but is transversely disposed, and passes almost straight to the pore. Sections demonstrate that the sperm-duct opens into the duct of the gland *at the junction of the gland with the muscular duct*, not at the free end, as in the Japanese species. Serial transverse sections are quite clear on the point. The sperm-duct leaves the body-wall, crosses the lower end of the gland immediately above its duct, bends down towards the latter, and opens into it just at the junction of the two. This can be followed out in the course of ten sections. The spermathecæ are in two pairs, lying in segments 8 and 9. Each consists of a globular sac, opening to the exterior by a narrow duct, which is longer than the sac itself. Each has a diverticulum (opening into the duct close to the body-wall), which is only about half as long as the duct and sac together. The ovaries are of considerable size, extending across the 13th segment.

Affinities, &c.—In a recent article Michaelsen (p. 220) has discussed the relations of the species of *Pontodrilus* occurring on the shores of the Pacific, viz.: *P. michaelsoni*, Eisen, California; *P. ephippiger*, Rosa (p. 281), from Christmas Island; and *P. matsushimensis*, Jizuka, Japan. He recognises the affinity of the two last, both presenting a distinct “tuberculum pubertatis” on the intersegmental groove 19/20, while differing in details. He further describes, briefly, a single somewhat damaged individual from Te One, in the Chatham Islands,

and concludes that it is a variety of the Japanese species. I cannot but think that his decision would have been different had he had a greater number of and better-preserved specimens at his disposal. Nevertheless, he recognises certain differences; chief amongst them being the presence in the Chatham Islands worm of preclitellian tubercles, in addition to the postclitellian tubercle (on 19/20). These he places at 11/12, 12/13, and 14/15, but remarks that they are "*undeutlicher umwandete*." In all the nineteen mature specimens in my possession, collected by two different persons at different times and probably at different spots, the tubercles are extremely well defined, having an oval margin well raised up from the surrounding skin; and, while presenting the first two tubercles (on 11/12 and 12/13), not one of them shows a trace of any similar structure at 14/15. Michaelsen is so experienced and so careful an observer that this discrepancy can only be due to the imperfect condition of his specimen; he has, I fancy, mistaken for an incipient intersegmental tubercle a transverse glandular ridge, which in most of my specimens exists on segment 14 between the ventral chætæ of the two sides. A similar more or less swollen ridge occurs, in several of my specimens, also on segments 15 and 16. But these are quite different in structure and in position from the intersegmental tubercles. Another point upon which my specimens disagree with his is in reference to the prostomium, for he states, "*Der Kopflappen ist quer oval, vom Kopfring scharf abgesetzt, und lässt keine Spur eines dorsalen Fortsatzes erkennen*." This is the more curious in that the Japanese species has this process, where, however, it reaches back to the hinder edge of the buccal segment.

A comparison of the Chatham Islands worm, as represented by my collection, with the Japanese species shows the following more or less important differences:—

Dimensions.	Segments.	Clitellum.	Papillæ.	Spermathecæ.	Spermiducal Gland.
<i>P. matsushimensis.</i>					
90-110 mm. by 3-3.5 mm.	100-105	12-17 (complete)	19/20	Diverticulum rather shorter than sac, which has no distinct duct	Much coiled; extending through segments 17 to 19, with long duct in 17 and 18.
<i>P. chathamensis.</i>					
100-125 mm. by 4.6 mm.	80	14-17 (saddle-shaped)	11/12, 12/13, 19/20	Diverticulum much shorter than sac, which has a long distinct duct	Little coiled; confined to 18th; short, fine, transverse duct.

It seems to me that the differences enumerated in the table are sufficient to raise our Chatham Islands form to the rank of a distinct species, for there are other details in which the two disagree. The thickened septa in the Japanese species are behind segments 5 to 13, whereas in ours only those behind 6 to 12; and even the first and last of these are not so thick as the rest of the group. The chætæ of the dorsal and ventral couples are equally spaced. The intestine in the Japanese form is said to commence in the 14th, while I find it beginning in the 20th. But most striking of these details is the point of entry of the sperm-duct into the duct of the spermiducal gland. Further, the geographical relations must, in the case of earthworms, have considerable weight in determining the question: for there is little, if any, communication between Japan and Chatham Islands.

5. *Microscolex huttoni*, n. sp.

Seventeen specimens collected in the "bush," Chatham Islands; preserved in formol.

Colour.—Pinkish—*i.e.*, unpigmented—with light-brownish clitellum.

Dimensions.—The usual length is $3\frac{1}{2}$ in., though one reaches 5 in. The diameter is $\frac{3}{32}$ in. (*i.e.*, 90–125 μ m. by 3.3 mm.). It is thus a slender worm, and contains 130 segments. Even the longest has only 136.

The *prostomium* is prolonged over a quarter of the length of the buccal segment.

The *chætæ* are arranged in four rather distant couples: $ab = cd < V$, $D = 3\frac{1}{2} cd$, $L = 2 ab$; or, put into proportionate numbers, measured on the flattened skin, $ab = cd = 3$, $V = 4$, $L = 5$, $D = 8$.

The *clitellum* is saddle-shaped, extending over segments 14 to 17; but the glandular thickening ceases ventrally at the level of chætæ *b*.

Genital Pores.—Each male pore is situated on a papilla on segment 17; from each pore there protrudes a long delicate penial chætæ, which, when magnified, is seen to curve rather abruptly at the free end, while the extreme tip is recurved to form a hook; it is without ornamentation. The spermathecal pores (two pairs) are invisible with a lens only; they lie, however, in the grooves $\frac{7}{8}$ and $\frac{8}{9}$, at the level of chætæ *b*.

In addition to these structures, there is a series of paired "tubercula pubertatis," or genital suckers. Each "sucker" is a circular glandular pad with a central depression; they are all situated in line with, and behind, chætæ *a*, close to the hinder margin of the segments, so as to appear at first sight intersegmental. The usual number, so far as can be judged from seventeen individuals, is three pairs, which are on

segments 11, 20, and 21, or 11, 21, and 22; in a few cases an additional pair may exist.*

I was unable to find any dorsal pores, even when the body-wall was mounted.

Internal Anatomy.

The dorsal vessel is single; the last heart is very large, lying in 12th segment, those in 10 and 11 being smaller. The worm is meganephric.

Alimentary Tract.—The gizzard, rather long, occupies the 6th segment; the œsophagus, with vascular walls, bears a single pair of "œsophageal glands" in the 13th segment. Intestine commences in the 18th, and is without a typhlosole.

Reproductive Organs.—The two pairs of testes lie in the normal segments. There are two pairs of lobulated sperm-sacs in segments 11 and 12 attached to the anterior wall, while the two segments 10 and 11 are filled with loose spermatozoa. The sperm-duct is slightly muscular at its hinder end as it enters the body-wall, passes behind the duct of the gland, and opens through the porophore by an independent aperture. The spermiducal gland is relatively large, extending backwards as far as the 25th segment, accompanied by the long sac with penial chætæ. The gland is somewhat tongue-shaped, and slightly curled at the posterior end; its muscular duct is short, limited to the 17th segment, and opens to the exterior in front of the sperm-duct and independently of it. The sac of penial chætæ opens by the same pore, though practically it is independent of the duct. The two pairs of spermathecæ lie in segments 8 and 9 respectively; each is a pyriform sac, with a thick muscular duct of its own length, with a diameter rather less than half that of the sac. There is a single tubular diverticulum opening near the end of the duct; it is relatively wide, slightly undulating, and not distended distally. Its diameter is greater than the duct, and its length about twice that of the sac and duct together.

Affinities, &c.—The present addition to our fauna makes the fourth species of *Microscolex* known to inhabit the Islands of New Zealand, for Mr. F. E. Beddard has already described three species. Though the descriptions are somewhat

* The facts of the variation may be summarised thus: In six specimens suckers are on segments 11, 20, and 21; in six, on 11, 21, and 22—in four of these additional suckers, small or unpaired, are present on 23; in one case, on 11, 19, 20, and 21; in one case, on 10, 11, and 21; in one case, on 11, 22, and unpaired on 23; and in one case, on 11 and 20. The 17th specimen is immature. There is thus a tendency to add suckers posteriorly.

meagre, yet they are quite sufficient to indicate the differences between them, as will be seen in the following table:—

Dimensions.	Segments.	Clitellum.	Spermatheca.	Spermiducal Gland.	Dorsal Pore.
<i>M. minutus.</i>					
2 in.-3 in.	100	14-17	Four pairs, in 6-9th segments.	Extends through seven segments	Post-clitellian.
<i>M. monticola.</i>					
1 1-5th in.	79	(?)	One pair in 9th	Long and coiled	Present.
<i>M. novæ-zealandiæ.</i>					
1 3-5th in.	76	13-17 (complete)	One pair in 9th	(?)	(?).
<i>M. huttoni.</i>					
3 in.-5 in.	100	14-17 (saddle-shaped)	Two pairs, 8th and 9th.	Extends through nine segments	None.

There are several other differences, such as the details as to the relative distances separating the chætæ, the form of penial chætæ, the shape of the diverticulum of the spermatheca, the arrangement of "tubercula pubertatis," but these are not known for all the four species,* and many are not capable of being tabulated. Sufficient, however, is known to characterize as distinct at least three of the species, for *M. novæ-zealandiæ*† and *M. monticola*‡ appear, from the brief summary given in Beddard's monograph, to be very closely allied. The latter species is one of the very few worms recorded from the North Island; it was collected at Mount Pirongia by Captain Broun.

This genus *Microscolex* is a very puzzling one, for, of the sixteen species known outside New Zealand, all but two (one of which is Algerian, the other Madeiran) inhabit the American Continent. Of these, eleven belong to South America and three inhabit California. There is a species (*M. dubius*) recorded from Australia and (*M. modestus*) from Italy, but each of these has been, almost beyond any doubt, conveyed to these localities by man from its home in the Argentine, where each occurs in abundance. Of the South American forms, nine possess only one pair of testes and of sperm-sacs, the remaining eleven species having these organs

* Beddard does not note them in *M. minutus*, but I find that in segment 18 a pair of large circular discs exist, just behind the male pore on segment 17.

† (5), p. 33.

‡ (6), p. 467.

repeated. But except for two of our New Zealand species—viz., *M. minutus** and *M. huttoni*—the entire genus is characterized by possessing a single pair of spermathecae. On this account Michaelsen has recently, in a revision of the New Zealand worms, suggested the resuscitation of Beddard's genus *Rhododrilus* for these species with more than one pair of spermathecae. Though this might be convenient, it seems to me at present inadvisable to follow him, for in all other anatomical features our two species are in thorough agreement with the genus *Microscolex*. And, even if we referred two of our species to *Rhododrilus*, we should still have to face the fact that we have two species of *Microscolex* in these Islands.

The existence of this genus here in New Zealand, with four distinct species, goes very far towards supporting the land connection with South America, and points, perhaps, rather to a connection with the northern part of the southern continent than with the extreme south. However, *Acanthodrilus macquariensis* must be regarded as lending a support to an antarctic continent.

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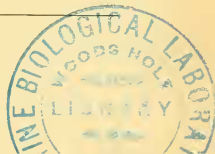
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EXPLANATION OF PLATES II.-IV.

The illustrations of the anatomy of the five earthworms described in this paper are purely diagrammatic, indicating only the segmental position of the various organs, the worm being supposed to be slit up along the dorsal line and the body-wall pinned aside.

A group of three diagrams refer to each worm herein described. The left-hand diagram in each of the groups referring to a species represents the external features. The location of the various genital pores is represented as round black dots (if on a papilla this is left white), the clitellum is obliquely shaded, the tubercula pubertatis are vertically shaded.

In addition, the arrangement of the chætæ—labelled *a*, *b*, *c*, *d*—is indicated in two segments in each case, usually in the 4th and the 21st; they are omitted in the remaining segments for clearness' sake. The true relative spacing of the chætæ is shown.

The position of the nephridiopores is given for one segment, except in the species of *Acanthodrilus*, in which it is necessary to note whether there is a linear or an alternate (zigzag) arrangement.

The middle figure represents the alimentary canal and so much of the vascular system as is diagnostic. The latter is black. The gizzard is indicated by vertical shading, the œsophageal glands by more or less horizontal lines. The intestine is not represented as being constricted, which is, however, the case in most worms.

The right-hand figure shows the reproductive system. The gonads are in black. The sperm-sacs are dotted. The sac with penial chætæ (cop.) when present is indicated, and the muscular duct of the spermiducal gland is transversely striped.

No attempt is made to give the relative sizes of the worms or of the various organs. Nor has it been considered necessary to label the various organs, since to any one who is familiar with the anatomy of any earthworm the structures here indicated will be sufficiently intelligible.
